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Rail Application Guide

TTI, Inc., – A Berkshire Hathaway Company



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The Specialist in Electronic Component Distribution



**Global Distribution Centres
with more than 120,000m²
of automated warehousing
in North America, Europe
and Asia.**

Why Choose TTI?

Founded in 1971, TTI has steadily grown to become a world leading specialist distributor of electronic components. The company was founded on the premise that passive component purchasing could be made more efficient by offering product specialization, customer-driven service and proprietary supply chain solutions.

Global Distribution Centres

Our European headquarters is located just outside of Munich, Germany in Maisach-Gernlinden. In total, we have 35.000m² of dedicated warehouse space and local sales and technical support in over 40 locations across Europe. TTI has more than 120,000m² of automated warehousing in North America, Europe and Asia. All are linked into a global warehouse management system that provides superior customer service and overall business efficiencies. Wherever you are in the world, TTI can support you.

Year after year, customers rate our inventory availability, on-time delivery and accuracy among the very best in the industry – contact us today to find out what a true specialist has to offer.

Quality and Reliability

TTI's global warehouses are all ISO-registered and have received certification to the ISO 9001 and ISO 14001 Standards. TTI Europe is also certified to EN9120/EN9100, IECQ-CECC and ISO/IEC 27001 Standards. Additionally, our European sales branches are ISO 9001 certified. TTI has one global documentation system that ensures that every TTI branch and warehouse in the world follows the same processes.



Rail Applications

Rolling stock

- Locomotive
- Carriages
- Wagons
- Freight trains

Rolling stock – Sub-systems

- Doors
- HVAC
- Braking systems
- Driver controls
- Lighting
- Multimedia

Energy, traction, power & control systems

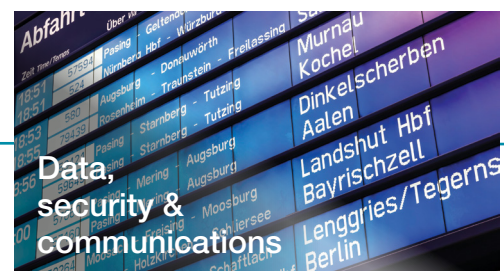
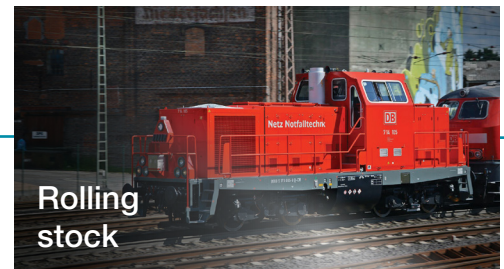
- Traction systems
- Motors
- DC/DC converters/inverters

Data, security & communications

- Rack systems
- Video screens
- Cameras
- Networking
- Antennas

Signalling & infrastructure

- Barriers
- Points
- Switches
- Ticket machines



Connectors



<p>Amphenol®</p>	<p>Amphenol®</p>	<p>Amphenol®</p>	<p>Amphenol®</p>
<p>EMP Series</p>	<p>GT Series</p>	<p>5015 Series</p>	<p>LPT – MIL-26482 Series I</p>
<ul style="list-style-type: none"> • Up to 500A and 3000V max • Various coding and shielding options • Spring fingers provide excellent shielding 	<ul style="list-style-type: none"> • Rugged aluminium or stainless steel shell styles • Variety of additional shell platings available 	<ul style="list-style-type: none"> • Circular, metal, multi-pin, threaded coupling • Ideal for harsh environments • SAE-AS50151 qualified • TTI offers in-house custom build capabilities 	<ul style="list-style-type: none"> • High strength, light weight • Multiple shell plating options • Stamped and formed contacts • TTI offers in-house custom build capabilities
			
<p>Amphenol®</p>	<p>Amphenol®</p>	<p> ITT <small>cannon</small></p>	<p> ITT <small>cannon</small></p>
<p>HeavyMate C146 Series</p>	<p>38999 Series</p>	<p>FRCIR Series</p>	<p>VRPC Series</p>
<ul style="list-style-type: none"> • Robust design • High number of poles for different kinds of signals • Very good EMC protection 	<ul style="list-style-type: none"> • MIL-DTL-38999 series III EN3645 qualified • 9 shell sizes (from 9 to 25) • 100% scoop proof • Metal and composite shells available 	<ul style="list-style-type: none"> • 1–159 poles and 256 layouts for signal, power and coax • IP67 environmental resistant • Flame retardant (EN 45545 HL3–NFPA 130) 	<ul style="list-style-type: none"> • Qualified for NFF 16-101 and NFF 16-102 • 80% lighter and 30% smaller than traditional technologies
			
<p> ITT <small>cannon</small></p>	<p> ITT <small>cannon</small></p>	<p> ITT <small>cannon</small></p>	<p> ITT <small>cannon</small></p>
<p>Power Plate Series</p>	<p>CIR M12 Series</p>	<p>Trident Series</p>	<p>CA Bayonet Series</p>
<ul style="list-style-type: none"> • Crimp contact up to 240mm² • Low contact resistance and good performance up to max 700A • Fast and easy coupling system 	<ul style="list-style-type: none"> • Available in 1 and 4 ways versions • 3 contact types: 2, 4 and 8-pole • Supports speeds up to 10 Gbps 	<ul style="list-style-type: none"> • Moulded latches or bayonet coupling • High voltage (up to 500 VAC) • Mixed power and signal layouts 	<ul style="list-style-type: none"> • Bayonet locking mechanism • IP67/68/69k rating • Shock and vibration proof • TTI offers in-house custom connector build capabilities
			

Connectors



<p>smiths interconnect</p>	<p>smiths interconnect</p>	<p>smiths interconnect</p>	<p>smiths interconnect</p>
<p>M12 Series</p>	<p>REP Series</p>	<p>Hypermod</p>	<p>LHS/LHZ Series</p>
<ul style="list-style-type: none"> • Superior contact performance • Contact assembly with clip insulator design • Fire & smoke compliance UL94V0 • TTI offers in-house custom kitting capabilities 	<ul style="list-style-type: none"> • 2, 6 and 12 way standard insulators • Crimp, straight or bent termination options 	<ul style="list-style-type: none"> • Robust connector system • Broad and versatile range of types available • Reliable contact technology 	<ul style="list-style-type: none"> • Floating connector to ease rack plugging • Built with low fire and smoke and toxicity material
<p>smiths interconnect</p>	<p>smiths interconnect</p>	<p>SOURIAU - SUNBANK Connection Technologies</p>	<p>SOURIAU - SUNBANK Connection Technologies</p>
<p>Transformer Heavy Power</p>	<p>L Series</p>	<p>SMS Flame Retardant</p>	<p>UTO / UTS</p>
<ul style="list-style-type: none"> • High density modular solution; High power, up to 300A/500A • Straight, angled and shunt termination styles 	<ul style="list-style-type: none"> • Mixed signal, power, coaxial, fiber optic and pneumatic modules • Provides up to 200amp power 	<ul style="list-style-type: none"> • Temperature (for the flame retardant version): -40°C to +105°C • Sealing: IP40 • 500 mating cycles 	<ul style="list-style-type: none"> • Operating temperature range: -40°C to +105°C • Sealing: IP68 and IP69K • UV resistant with F1 material
<p>SOURIAU - SUNBANK Connection Technologies</p>	<p>SOURIAU - SUNBANK Connection Technologies</p>	<p>SOURIAU - SUNBANK Connection Technologies</p>	<p>SOURIAU - SUNBANK Connection Technologies</p>
<p>VGE 1</p>	<p>38999 Series</p>	<p>FER1</p>	<p>851 Series</p>
<ul style="list-style-type: none"> • RoHS compliant • Fire & smoke certified according to EN4554-2 • TTI offers in-house custom connector build capabilities 	<ul style="list-style-type: none"> • MIL-DTL-38999 series III, EN3645, BACC63, CECC • Available in 5 high end materials and 5 platings • TTI offers in-house custom build capabilities 	<ul style="list-style-type: none"> • Operating temperature range: -40°C to +125°C • Salt spray: 500h • IP67 in mated condition (static and dynamic) 	<ul style="list-style-type: none"> • Temperature: -55°C to +125°C • 500 mating/unmating mating cycles • Salt spray resistance: 500h • TTI offers in-house custom build capabilities

Connectors

 <p>AUTHORIZED DISTRIBUTOR</p>	 <p>AUTHORIZED DISTRIBUTOR</p>	 <p>AUTHORIZED DISTRIBUTOR</p>	 <p>AUTHORIZED DISTRIBUTOR</p>
<p>FXP</p>	<p>EKO</p>	<p>CPP</p>	<p>SRC</p>
<ul style="list-style-type: none"> • Multiple possible configurations with just 10 connector variants • Cable cross-sections from 50 up to 300mm² 	<ul style="list-style-type: none"> • High level of performance • Straight and 90 degree connection • Compact and weight-saving • Halogen free 	<ul style="list-style-type: none"> • High dynamic applications • High vibrations resistance • Ruggedized power connector • Field-proven solutions from metro to high speed train 	<ul style="list-style-type: none"> • NFF 61-030 standard compliant • Broad range of accessories • Field-proven • EN 45545-2 compliant
			
 <p>AUTHORIZED DISTRIBUTOR</p>	 <p>AUTHORIZED DISTRIBUTOR</p>	 <p>AUTHORIZED DISTRIBUTOR</p>	 <p>AUTHORIZED DISTRIBUTOR</p>
<p>NGC</p>	<p>CMC</p>	<p>HDC</p>	<p>Rail M12</p>
<ul style="list-style-type: none"> • Compact and cost-effective solutions • High level of performance • Halogen free • Field-proven 	<ul style="list-style-type: none"> • Ruggedized hybrid: signal/optic/data connector • According to NFF61030 standard • Field-proven solution from metro to high speed train 	<ul style="list-style-type: none"> • EN45545-2 compliant inserts • Rectangular, multiple position pin and socket connectors • Most popular housing shell sizes: 1, 3, 4, 5, 6, and 8 	<ul style="list-style-type: none"> • M12 can operate between -30°C and +85°C • Shielded for 360 degree protection from EMI and RFI
			
 <p>AUTHORIZED DISTRIBUTOR</p>	 <p>AUTHORIZED DISTRIBUTOR</p>	 <p>AUTHORIZED DISTRIBUTOR</p>	 <p>AUTHORIZED DISTRIBUTOR</p>
<p>M12 X-Coding</p>	<p>High Speed Rail Data Cables</p>	<p>Rail Antennas</p>	<p>Ethernet Switches</p>
<ul style="list-style-type: none"> • Insulation Displacement Contacts (IDC) • Tool-less assembly installation • Speed up to 10 GB/s 	<ul style="list-style-type: none"> • CAT 7 4 pair, CAT 5 quad and 120 ohm profibus cables • Halogen-free, flame-retardant meeting EN45545-2 standards 	<ul style="list-style-type: none"> • Combining multiple services such as 2G/3G/4G/5G/LTE, Wi-Fi and GPS/GNSS in a single antenna package • Meeting industry standards 	<ul style="list-style-type: none"> • 5-24 ports supporting M12 connectivity • Data speeds up to 10Gb/s • EN50155 compliant
			

Power Supplies & Relays

			
<p>ERM 20 Series</p>	<p>ERM 75 Series</p>	<p>PKM-W</p>	<p>PKJ</p>
<ul style="list-style-type: none"> • 20W, 2"x1" DC-DC converter designed for railway • Vin range: 9–36V, 18–75V and 40–160V • Vout: 5, 12, 15 or 24V, +/-12V and +/-15V 	<ul style="list-style-type: none"> • 75W, 1/4 brick footprint • DC-DC converter specifically for railway applications • Vin: 66–160 Vdc input • Vout: 5, 12, 15 or 24V 	<ul style="list-style-type: none"> • 50–100W, 1/4 brick ultra-wide input EN50155 • DC/DC input: 12–160V (50W) 14–160V (100W) • Out: 5, 12, 13.8, 15, 24, 48 and 54V 	<ul style="list-style-type: none"> • 200–300W EN50155 compliant • Half brick DC/DC converter for railway applications • Vin: 60–160V • Vout: 12, 24 or 48V
			
			
<p>PKM-A</p>	<p>RSD Series</p>	<p>IRS Series</p>	<p>IRE Series</p>
<ul style="list-style-type: none"> • 100–150W EN50155 compliant • 1/4 brick DC/DC for railway applications • Input range: 60–160V • Out: 5, 12, 13.8, 15, 24, 48 and 54V 	<ul style="list-style-type: none"> • 300 Watt, stand alone • Compliance to EN50155 and EN45545-2 • Vin 16.8– 31.2V, or 33.6–62.4V • Vout 5, 12, 24, 48V 	<ul style="list-style-type: none"> • 50W 1/16 brick • Optimised for harsh environment • Compliant to EN50155 • Vin range: 9–36V • Vout 3.3, 5, 12, 15 or 24V 	<ul style="list-style-type: none"> • 120W 1/8 brick fully regulated • Compliant to EN50155 • Vin range: 9–36V • Vout 5, 12, 15 or 24V
			
			
<p>IRH Series</p>	<p>IRQ Series</p>	<p>HRDI Timer Relays</p>	<p>SF2D Safety Relays</p>
<ul style="list-style-type: none"> • 150W 1/2 brick fully regulated • Designed to highest reliability • Compliant to EN50155 • Vin range: 57.6–160V • Vout 5, 12 or 24V 	<ul style="list-style-type: none"> • 150W 1/4 brick • Optimised for harsh environment • Compliant to EN50155 • Vin range: 57.6–160V • Vout 5, 12 or 24V 	<ul style="list-style-type: none"> • Alternating, counters and delay on break • Delay on make, HVAC, interval and multifunction • Percentage, recycle and single shot 	<ul style="list-style-type: none"> • Relay complies with IEC 61810-3, Type A • Overvoltage category IEC 60664-1 III/4kV • Rated voltage as per IEC 60664-1
			

Relays, Switches & Sensors

			
<p>DRH SSR (Solid State Relays)</p>	<p>MT3 + MT78740 Industrial Relays & Sockets</p>	<p>W6/W9 Circuit Breakers</p>	<p>Cradle Relays</p>
<ul style="list-style-type: none"> • Over-voltage protection • Over-temperature alarm output • Enclosed heat sink, eliminating earth connections • AC or DC control 	<ul style="list-style-type: none"> • 2/3 pole 10A, 2 form C (CO) or 3 form C (CO) contacts • DC and AC coils • Mechanical indicator as standard • Electrical indicator 	<ul style="list-style-type: none"> • UL, CSA and VDE approved • Ratings to 50 amps • #10-32 stud connections (W9) • Quick-connect or screw terminals (W6) 	<ul style="list-style-type: none"> • Highly reliable multi-purpose relay • A great variety of contact arrangements and materials available • Contacts for signal loads and currents up to 5 A
			
			
<p>HS Series Joysticks</p>	<p>AV Series Push Button Switches</p>	<p>PBA Series Push Button Switches</p>	<p>APB Series Backlit Pushbutton Switches</p>
<ul style="list-style-type: none"> • 5-way with centre pushbutton option • Positive tactile feedback • Mom-off-momentary action • Threaded bush mount option 	<ul style="list-style-type: none"> • Safety pushbutton switches • Flat or curved actuator available • Illuminated or non-illuminated • Nickel, chrome plated or stainless steel 	<ul style="list-style-type: none"> • Sealed to IP68 or IP69K (Switches mounted on panel) • Easy to clean metal surface • Long life (50 million cycles) • Ring illumination 	<ul style="list-style-type: none"> • IP67 sealed • 1,000,000 life cycles • Illumination • Threaded or snap-in mounting
			
			
<p>ZMS Series Subminiature Snap Action IP65</p>	<p>QH Series E STOP with Halo</p>	<p>NGC Series Limit Switches</p>	<p>T3000 CO² Sensor</p>
<ul style="list-style-type: none"> • Reliable snap-acting mechanism • Long electrical and mechanical life • Compact size – ideal when space is limited 	<ul style="list-style-type: none"> • Hyper bright LEDs in a choice of colours • IP67 sealed as standard • The QH is easily mounted and supports switches with a 16mm, 19mm or 22mm cut out 	<ul style="list-style-type: none"> • Configurable SPDT or DPDT circuitry • IP67 sealed with 380,000 configurations • For potential use in indoor and outdoor applications 	<ul style="list-style-type: none"> • Accurate CO² transmitter for HVAC applications • Rated to IP67 and can be potted • Easy mount with 2 external tabs
			

Sensors, Antenna & Electromagnetics







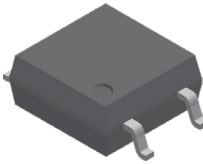



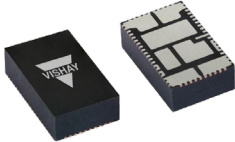
<p>Amphenol Advanced Sensors</p>	<p>Honeywell</p>	<p>Honeywell</p>	<p>Sensata Technologies</p>
<p>JS8746 Temperature Sensor</p>	<p>TARS Inertial Measurement Unit</p>	<p>SN-Q Series Speed & Direction Sensor</p>	<p>2CP Pressure Sensors & Switches</p>
<ul style="list-style-type: none"> • HACT Exposure: +14 days • Temp Rating: -40 to 120 C • Environmental Protection: IP68 	<ul style="list-style-type: none"> • On-board firmware can be customized to design • Sealed to IP67, IP69K ruggedized to withstand harsh or heavy-duty applications. 	<ul style="list-style-type: none"> • Provides both speed and direction output • Plastic housing 45mm length with 500mm cable 	<ul style="list-style-type: none"> • Ceramic capacitive sensor • Durable, compact, low-cost design • Accurate performance over wide temperatures
			
<p>Sensata Technologies</p>	<p>SGX SENORTECH</p>	<p>TE connectivity AUTHORIZED DISTRIBUTOR</p>	<p>TE connectivity AUTHORIZED DISTRIBUTOR</p>
<p>112CP Pressure & Temperature Sensor</p>	<p>R290/R32 INIR CO2 Gas Sensor</p>	<p>U7100 Pressure Transducer</p>	<p>8911 Wireless Accelerometer</p>
<ul style="list-style-type: none"> • Pressure and temperature measurement in one sensor package • Precise superheat measurement 	<ul style="list-style-type: none"> • Gas sensor with automatic switchover between ranges, • High resolution up to 20ppm • Detectivity level at 100ppm • Multi-sensor mode 	<ul style="list-style-type: none"> • Rugged for heavy equipment and outdoor use such as transport HVAC refrigeration systems • Suitable for measuring liquid or gas pressure 	<ul style="list-style-type: none"> • Acceleration and temperature output • Compact design, stud mount • Up to 5-year battery life • Low power consumption
			
<p>AVX A KYOCERA GROUP COMPANY</p>	<p>TE connectivity AUTHORIZED DISTRIBUTOR</p>	<p>Pulse A YAGEO Company</p>	<p>VISHAY</p>
<p>Antennas</p>	<p>RF Solutions</p>	<p>Hi Rel Transformers</p>	<p>IHLE Inductors</p>
<ul style="list-style-type: none"> • Telematics • Ecall • Tracking • Infotainment • Navigation 	<ul style="list-style-type: none"> • TE's new standard portfolio of GNSS antennas address key antenna performance goals 	<ul style="list-style-type: none"> • Multiple packaging and configurations available 	<ul style="list-style-type: none"> • Vishay has expanded its IHLE series of low-profile, high-current inductors
			

Capacitors, Circuit Protection & Resistors



 <p>AVX A KYOCERA GROUP COMPANY</p>	 <p>KEMET a YAGEO company</p>	 <p>knowles PRECISION DEVICES COMFEX • DLI • JOHANSON MED NOVACAP • SYFER • VOLTEONICS</p>	 <p>Panasonic INDUSTRY</p>
<p>Supercaps</p>	<p>Large Can Aluminium Capacitors</p>	<p>Hi Rel MLCC and Filters</p>	<p>Film Caps (Ecqua Series)</p>
<ul style="list-style-type: none"> • These two ranges are the most cost effective solution from AVX supercapacitors portfolio 	<ul style="list-style-type: none"> • The ALS70 and ALS80 Series from KEMET are high CV screw terminal electrolytic capacitors 	<ul style="list-style-type: none"> • High reliability components for critical environments 	<ul style="list-style-type: none"> • Guaranteed moisture resistance of 85°C, 85%, 500h under loaded conditions
			
 <p>TDK</p>	 <p>Littelfuse</p>	 <p>YAGEO</p>	 <p>muRata INNOVATOR IN ELECTRONICS</p>
<p>CeraLink</p>	<p>Power Fuse</p>	<p>MLCC</p>	<p>Thermistors</p>
<ul style="list-style-type: none"> • DC Link and snubber capacitors for compact power electronics 	<ul style="list-style-type: none"> • The 885 Nano2® surface mount fuses are high voltage rated fuses 	<ul style="list-style-type: none"> • MLCC for soft termination and AQ series MLCC for high frequency 	<ul style="list-style-type: none"> • Murata NTC thermistors employ elements featuring high precision and good thermal response
			
 <p>BOURNS</p>	 <p>KOA</p>	 <p>TT Electronics</p>	 <p>VISHAY</p>
<p>Current Sense CSS2H</p>	<p>SG73 Series</p>	<p>GHVC Resistor</p>	<p>Power Metal Plate™ Current Sense Resistors</p>
<ul style="list-style-type: none"> • The Bourns® Model CSS Series comes in both 2-terminal (2512; 3920; 5930) and 4-terminal (4026) options 	<ul style="list-style-type: none"> • SG73S, SG73P and SG73G series with tighter tolerances down to ±0.25% 	<ul style="list-style-type: none"> • GHVC is essentially a variant of high voltage chip resistor 	<ul style="list-style-type: none"> • Feature high 2W and 3W power ratings and resistance range from 5mΩ to 500mΩ
			

Discrete Components

			
<p>5KP60A, Axial Leaded – 5kW</p>	<p>VO2611, High Speed Optocoupler, 10 MBd</p>	<p>VSKC71/12, Power Modules 80 A</p>	<p>VS-130-160MT..KPbF Series, Three Phase Bridge</p>
<ul style="list-style-type: none"> • 5kW peak pulse capability • Fast response time • Excellent clamping capability 	<ul style="list-style-type: none"> • High speed: 10MBd typical • +5 V CMOS compatibility 	<ul style="list-style-type: none"> • High voltage • Industrial standard package • Low thermal resistance 	<ul style="list-style-type: none"> • Excellent power volume ratio • 4000 VRMS isolating voltage
			
			
<p>VOM1271, Photovoltaic MOSFET Driver</p>	<p>VS-VSK.170PbF, Power Module 170 A, 250 A</p>	<p>VS-ST173C Series, Inverter Grade Thyristors</p>	<p>VOM453, Analog High Speed Coupler</p>
<ul style="list-style-type: none"> • Logic compatible input • Integrated rapid turn-off circuitry 	<ul style="list-style-type: none"> • High voltage • Electrically isolated base plate • High surge capability 	<ul style="list-style-type: none"> • High surge current capability • Low thermal impedance • High speed performance 	<ul style="list-style-type: none"> • High Isolation test voltage • Very high common mode transient immunity • High speed
			
			
<p>DG506BEN-T1-GE3, CMOS Analog Multiplexers</p>	<p>VO3120, IGBT and MOSFET Driver</p>	<p>SIC931, DC/DC Regulators POL solutions</p>	<p>VCNL4035, Proximity & Ambient Light Sensor</p>
<ul style="list-style-type: none"> • High performance analog Multiplexer • Ultra-low switch charge injection 	<ul style="list-style-type: none"> • High operating voltage range • Ideal for directly driving IGBTs 	<ul style="list-style-type: none"> • 4.5 to 16V input voltage • 95% peak efficiency • SMD package • Inductor integrated 	<ul style="list-style-type: none"> • Four different slave addresses • Saves PCB space • Programmable interrupt function
			



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Contact TTI today to see what a true specialist can offer.

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